Japan Patent Office (JP)

Public Report of Opening of the Patent

Opening No. of patent: S 63-74618
Date of Opening: April 5, 1988

Int.Cl.	Distinguishing mark	Adjustment No. in office	FI
B 29 C 45/26		2114-4F	
G 11 B 7/24		Z-8421-5D	
B 29 L 11:00		4F	
17:00		4F	

Request of examination: pending, Number of invention: 1

Name of the invention: MOLD FOR PLASTIC DISK SUBSTRATE
Application No.: S 61-219358
Date of application: Sep. 19, 1986
Inventor: Kiei Kotera
Hitachi Co. Ltd., 292 Yoshida-cho Totsuka-ku, Yokohama-shi, Kanagwa, Japan
Inventor: Hisao Inage
Hitachi Co. Ltd., 292 Yoshida-cho Totsuka-ku, Yokohama-shi, Kanagwa, Japan
Inventor: Masao Takagi
Hitachi Co. Ltd., 292 Yoshida-cho Totsuka-ku, Yokohama-shi, Kanagwa, Japan
Applicant: Hitachi Co. Ltd.
6 4-chome Kanda Surugadai, Chiyoda-ku, Tokyo
Assigned Representative: Katsuo Ogawa, Patent Attorney, and 1 another

Detailed Report

1. Name of the invention

MOLD FOR PLASTIC DISK SUBSTRATE

2. Sphere of application of patent

(claim 1)

In the field of injection molding disk substrates by filling a mold cavity with molten resin, this invention is regarding a mold die for a plastic disk substrate which uses heat insulating material for the cyclic parts which form the edge of the cavity.

(claim 2)

Claim 2 is regarding the mold for a plastic disc substrate in claim 1 which uses a ceramic made of silicon nitride, zirconia, or alumina as the main component for the heat insulating material.3. Detailed explanation of the invention

(field of industrial use)

This invention is regarding a mold for plastic. Especially, it is regarding a mold for plastic which is suitable for molding an optical disk substrate for a digital memory optical disc.

(Prior art)

In the former mold for plastic, temperature adjustment of the edge of the disk substrate is not usually considered. Because of this, the edge of the disk substrate has a thermal gradient in the peripheral direction as shown by arrow 12 in figure 3. Thermal shrinkage of other areas which cooled after the edge creates internal stress in toward the center of the disk substrate. This stress will be relieved simultaneously when the part is removed from the mold, and warping or other deformation is produced near the edge. In addition, sink marks may easily occur in the boundary between the edge which is cooled rapidly and other areas that are cooled later.

Therefore, in order to solve the above problems, Japan patent No. S 58-224730 suggested a mold which adjusts the temperature of the edges simultaneously.
Figure 4 is a section of the main part of the above mold which adjusts the temperature of edge. In figure 4, the cavity 3 is formed by upper and lower core blocks 1 and 2. 4 is a thermal medium passage which is used for adjustment of the mold temperature. This thermal medium passage 4 is formed on the opposite face of the upper mold 5 and lower mold 6 of the upper and lower core blocks 1 and 2. A gate 7 which connects to the cavity 3 is also connected to the resin pouring opening 8.

Meanwhile, the annular material 9 which forms the edge of the cavity 3 has a thermal medium passage 4' and also is combined with the lower mold 6 so that an air gap 10 can be constructed if necessary. 11 is a stamper.

According to the above construction, after filling the cavity 3 with molten resin through the resin passage 8 and gate 7, the temperature of part 3a which is equivalent to

the edge of the disk substrate is mainly controlled by a thermal medium which flows in the thermal medium passage 4' set up in the annular part 9. Other areas of the disk substrate are controlled by a thermal medium which flows in the thermal medium passage 4.

Thus, when using this mold, since there will be no internal stress which accompanies uneven cooling of the edge of the disk substrate, it is possible to form a disk substrate with no sink marks or warping.

(Problems that this invention tries to solve)

However, the annular part in this mold forms a thermal medium passage 4' which is formed in two parts of the mold. It uses an o-ring to prevent leakage of the thermal medium from adjoining faces of these two parts and connecting parts to contain the thermal medium.

Therefore, the annular part above has a complicated construction and also is expensive. Temperature adjustment of this annular part has to be controlled differently for the upper and lower core blocks 1 and 2, and it requires a die temperature adjustment device for precise control.

Because of this, this die temperature adjustment equipment is expensive. Along with the above annular passage, it is an obstacle when trying to reduce the price of the disk substrate.

This invention was made in order to solve these problems. Its object is to simplify construction of the annular part and to reduce manufacturing cost not eliminating the need for temperature adjustment of the edge of the cavity and also to offer a mold which will not produce sink marks or warping at the edge of the disk substrate.

(Step for solution)

In order to attain these objects, this invention uses heat insulating material for the annular part which forms the edge of cavity.

(Function)

The annular part of this invention reduces heat transfer from the resin through the annular part, and cooling of the disk substrate is accomplished only through the upper and lower core blocks. Because of this, there will be no more uneven cooling at the edge of the disk substrate, and sink marks and warping of the disk substrate can be prevented.

(Example of practice)

In the following, this invention is going to be explained in detail using figures. Figure 1 is a section of a cavity which shows one example of practice of this invention; figure 2 is a model which shows the principle of this invention.

In figure 1, 1 is the upper core block and 2 is the lower core block which form the cavity 3 along with the stamper 11. This cavity 3 is formed so that the molded product will be in disk shape and its outer diameter is formed by the annular part 10.

In the upper and lower core blocks 1 and 2 above, a thermal medium passage 4 for controlling the temperature of the core blocks is formed. 5 is the upper mold, 6 is the lower mold, and the core blocks 1and 2 are fixed in them.

The annular part above has thermal insulating effect and also is durable enough for the molding conditions such as injection pressure, resin temperature, and clamp pressure. At the same time, the face of the cavity 3 has to be finished smoothly. Preferably, ceramics parts that have silicon nitride (Si3N4), zironica (ZrO2), alumina (Al2O3) as their main components are the best.

In the mold of this invention which has the above structure, molten resin fills the cavity 3 through a sprue 8 and gate 7.

Heat from the resin in the cavity is transferred through the core blocks and into the thermal medium passage which is formed in the upper and lower core blocks 1 and 2. At this point, heat at the edge 3a of the disk substrate will not move in the direction of the arrow 12 in figure 2 due to the insulating function of the annular part 10.

Accordingly, as shown by the arrow 13 in figure 2, heat from the edge 3a of the disk substrate is thermally transferred only in the direction of thickness just like the other parts, and cooling will be uniform at every section, resulting in uniform shrinkage. As a result, the cooled disk substrate does not develop molding defects such as warpage, sink marks, deformation, etc.

Since sink marks that occur at the edge of the disk substrate can be prevented, former problem recording data at the edge of disk substrate can be eliminated, and it is possible to increase data capacity.

(Effects of this invention)

As is obvious from the above explanation, according to this invention, since the annular part which forms the edge of the mold cavity for the disk substrate is made from a heat insulating material, there is hardly any heat transfer from the edge of the disk substrate. Heat transfer is only in the direction of thickness over the total face of the disk substrate.

Because of this, molding defects such as sink marks and warpage due to uneven cooling of the disk substrate can be eliminated. In addition, controlling the temperature of annular parts is not necessary, so the construction will be simple. This invention can be used to produce a relatively inexpensive mold for a disk substrate with stable quality.

4. Simple explanation of figures

Figure 1 is a section of the main part of a mold for a plastic disk substrate which shows one example of this invention. Figure 2 is a model which shows the heat transfer at the edge of the disk substrate for the mold in this invention. Figure 3 is a model which shows the heat transfer at the edge of the disk substrate for an example of a former mold. Figure 4 is a section of the main part of a mold for a of plastic disk substrate in the former example.

1: upper core block, 2: lower core block, 3: cavity, 4: thermal medium passage, 10: cyclic part

Assigned Representative: Katsuo Ogawa, Patent Attorney